

CAPACITIVE VOLTAGE DIVIDER

BACKGROUND OF THE INVENTION

This application is a continuation-in-part of copending application Ser. No. 837,820, filed June 30, 1969 and now abandoned.

The present invention relates to a capacitive voltage divider arrangement for use in a position transducer for handprint data entry and the like.

Electronic position transducers, and more particularly electronic writing tablets, employing a tablet-stylus arrangement are well known in the art. A variety of techniques have been employed for electronically determining in time the position of the stylus as it is moved across the surface of the tablet. Some of these techniques have been summarized in copending application Ser. No. 772,295, filed Oct. 31, 1968 and assigned to the same assignee as the present invention.

As stated in the above-cited application, both analog and digital techniques have been employed to drive the position transducing tablet. One approach used in analog voltage driven tablets is to use some form of voltage division arrangement where the voltage drop of the driving voltage is a function of position.

One of the difficulties of the analog voltage divider arrangement is obtaining a voltage drop which is a linear function of position. In this respect conventional forms of resistive dividers may, in some instances, provide adequate linearity but such are bulky, expensive and difficult to fabricate. On the other hand the less costly, less bulky and simpler forms, such as photoetched and the like type resistive dividers, do not always provide good linearity as it is difficult to fabricate a thin layer of resistance which is of uniform resistivity. In general, it may be said that resistive dividers are susceptible to heat and reliability problems as well as presenting manufacturing, fabrication and packaging problems. For that matter, in either the analog divider or digital type tablets, known heretofore in the art, a break in one of the X-Y grid voltage distribution lines during fabrication or use would effect an open circuit and loss of voltage at that point, thus affecting accuracy and reliability.

In accordance with the principles of the present invention there is provided a novel capacitive voltage divider for a position transducer which is simple, inexpensive and easy to fabricate and which exhibits linearity in the amplitude of its voltage division as a function of position, low power loss and high reliability. The novel capacitive divider of the present invention basically comprises a first plurality of parallel capacitors with one of the plates of each capacitor all conductively coupled together and varying in area in accordance with the desired voltage function to be sensed in space. Thus, to obtain a monotonical voltage increase as a function of position, the areas would be made to progressively increase.

Coupled respectively to the other plate of each of the capacitors are respective grid lines distributed over the transducer position sensing surface. A second like plurality of capacitors, which capacitances are the complement of the first plurality, may also be employed with said first plurality to provide good linearity and a means of obtaining a reference potential. In addition, a second set of first and second plurality of capacitors connected to the respective grid lines insures high reliability, accuracy and simplicity in fabrication.

Accordingly, it is an object of this invention to provide an improved voltage divider for a position transducer.

It is a further object of this invention to provide a capacitive voltage divider for use in a position transducer.

It is a further object of this invention to provide a position transducer which provides linearity in the voltage sensed as a function of position.

It is yet another object of this invention to provide a voltage divider for a position transducer which is simple, inexpensive and easy to fabricate.

It is still a further object of this invention to provide a voltage divider for a position transducer which exhibits low power loss and high reliability.

It is still yet a further object of this invention to provide a voltage division impedance distribution network for the position transducer writing tablet of a graphic data entry terminal which is thin, light, flexible and easily and inexpensively fabricated.

The foregoing and other objects, features and advantages of the invention will be apparent from the following more particular description of preferred embodiments of the invention, as illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a single axis version of the capacitive voltage divider position transducer in accordance with the principles of the present invention.

FIG. 2 shows a two-dimensional capacitive voltage divider position transducer arrangement in accordance with the principles of the present invention.

FIG. 3 shows the relationship of the time intervals during which the drive plates of the arrangement in FIG. 2 are energized.

FIG. 4 shows a cross-sectional view of the capacitive voltage divider position transducer of FIG. 2, in a possible writing tablet form.

DETAILED DESCRIPTION OF THE DRAWINGS

In the single direction position transducing arrangement shown in FIG. 1 a plurality of conductive grid lines or strips 1'—15' are shown conductively connected to the respective capacitor plates 21'—35'. Plates 21'—35' may be of the same material as and integral with the conductive grid lines so that the grid lines merely widen at the ends thereof into capacitive coupling pads. Position sensing in FIG. 1 is in the X-direction, as indicated by the arrow. Between each of the respective plates 21'—35' and triangular plate 17' beneath these plates there is provided a layer of dielectric such that each of the plates 21'—35' are capacitively coupled to plate 17' so as to provide an array of capacitances 16' wherein one of the capacitance plates 17' of each capacitance of the array of capacitances is of integral form. The cutaway portions of plates 33' and 35', for example, show dielectric at 32' and 34'.

Also capacitively coupled to each of the grid lines 1'—15' is plate 19' acting to provide a fixed capacitance voltage division path to ground for each grid line with the grid lines, it is clear, thereby acting as voltage taps for the divided voltage. Thus, between each of the grid lines 1'—15' and plate 19' there is provided dielectric, as shown for example at 12' and 14', which is uniform in thickness across the array.

As shown in FIG. 1 the area of the respective capacitance plates of the array of capacitances 16' increase in size in the X-direction. Accordingly, when plate 17' is energized by AC source 18', the voltage appearing on the respective conductive grid lines 1'—15', increases in the same direction. Thus, it can be seen that voltage changes as a function of position in the X-direction because of the geometry of plate 17'. With each plate 21'—35' of equal width and equally spaced in the X-direction the output voltage sensed on grid lines 1'—15' changes from grid line to grid line, and therefore with position, according to the nonlinear function,

$$Vo(X) = \frac{C_{x1}}{C_t + C_{x1}}$$

where C_{x1} represents the particular capacitance between individual ones of respective plates 21'—35' and plate 17' and C_t represents a fixed capacitance between the individual grid lines 1'—15' and plate 19' which is grounded. In this respect C_t is made large as compared to any stray capacitance to ground.

It is clear, however, that the output voltage can be made to vary linearly with position by adjusting the parameters of the FIG. 1 arrangement to compensate for the nonlinearity of the

$$\frac{C_{x1}}{C_t + C_{x1}}$$